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INTERNATIONAL
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INTERGOVERNMENTAL
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INTERNATIONAL TSUNAMI INFORMATION CENTER

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TSUNAMI NEWSLETTER is published by the International Tsunami Information Center to bring news and information to scientists, engineers, educators, community protection agencies and governments throughout the world.

We welcome contributions from our readers.

The International Tsunami Information Center is maintained by the U.S. National Oceanic and Atmospheric Administration for the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization. The Center's mission is to mitigate the effects of tsunamis throughout the Pacific.

MEMBER STATES

Present membership of the International Coordination Group for the Tsunami Warning System in the Pacific comprises of the following States:

CANADA
CHILE
CHINA
COLOMBIA
COOK ISLANDS
ECUADOR
FIJI
FRANCE
GUATEMALA
INDONESIA
JAPAN
KOREA (REPUBLIC OF)
MEXICO
NEW ZEALAND
PERU
PHILIPPINES
SINGAPORE
THAILAND
UNITED KINGDOM (HONG KONG)
USA
USSR
WESTERN SAMOA

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FEATURE

The following article is a United States National Oceanic and Atmospheric Administration (NOAA) internal document dated September 26, 1980. The author, Mr. J. Gordon Vaeth, is now the Director of the Office of Satellite Operation of the National Environmental Satellite Service (NESS) of NOAA.

"Disaster Warning Using the GOES Satellite"

By J. Gordon Vaeth

Abstract: The islands and territories of the Pacific Basin frequently feel the fury of tsunamis, often called seismic sea waves or tidal waves. Unfortunately communications through the area and to its inhabited places are not always timely or reliable. The interrogation downlink (468 MHz) of the GOES Data Collection System holds promise for improving the ability of the peoples of the Basin to receive tsunami and other natural disaster warnings. This paper describes how this could be achieved using that link with a specially-designed low cost (less than $1000 U.S.) receiving station that would issue an oral warning in the local language.

Twenty years ago -- at 1:05 AM on May 23rd 1960 -- a wall of water 20 feet high roared ashore at Hilo on the island of Hawaii. It smashed into the downtown area, demolishing ten city blocks, destroying 537 buildings, and causing $23 million of damage. There were 62 people killed and 282 injured.

What struck Hilo that morning -- and what had struck it in a like manner 14 years before leaving 173 dead -- was a tsunami or seismic sea wave. It had originated off the coast of Chile and had travelled across the Southeast Pacific to Hawaii to an average speed of 440 miles per hour (710 km/hr).

Tsunamis are among the most dangerous and destructive of all Nature's forces. Less than a year ago, for example, on December 12, 1979, a tsunami created by a local seaquake took a toll of 200-800 dead in Western Colombia. So widespread is the tsunami danger throughout the Pacific Ocean Basin that some dozen nations, including Canada, Chile, Ecuador, France, Guatemala, Japan, Korea, New Zealand, Peru, the Philippines, Thailand, the USSR, and the United States have formed an international coordination group for tsunami warning in the area. The National Weather Service of the United States operates two tsunami warning centers for the Pacific, one in Palmer, Alaska, the other near Honolulu, Hawaii.

The hardest part in giving warning of an approaching tsunami is not in detecting it -- Nature sees to that -- but in communicating the warning quickly and reliably enough. Conventional communications throughout the Pacific Basin, the main tsunami area, leave much to be desired. Tests of the tsunami warning network have revealed delays in warning reception incompatible with public safety.

How can the timeliness of these warnings -- and the number of inhabited places in the Pacific that can receive them -- be improved upon?

GOES, the Geostationary Operational Environmental Satellite of the United States, holds promise of making this possible by broadcasting them over the platform-interrogation downlink of its Data Collection System (DCS).

GOES is best known for the meteorological imagery provided by its Visible and Infrared Spin Scan radiometer. Audiences, even astronautics audiences, are far less familiar with its Data Collection System involving the observations made by buoys, river gages, tide gages, seismometers, aircraft, magnetometers, and other in-situ environment-sensing platforms. Radio sets that are part of these platforms transmit the observational data up to GOES which relays them to earth stations for centralized or individual distribution to users. Those radio sets operate in three modes: (1) self-timed, (2) adaptive random reporting, which is to say they come on the air only when they have some data of significance to report, and (3) interrogated. Interrogation is accomplished by a downlink (468 MHz) from the spacecraft which uses it to send addresses with accompanying interrogations and commands.

The National Environmental Satellite Service routinely keeps two GOES in operation over the equator at 75° West and 135° West. The westernmost has a communications field of view encompassing most of the Pacific Ocean Basin, the tsunami-prone area. The downlink over which it broadcasts interrogations and commands to DCS platforms in that region could also be used to broadcast warnings to islanders and coastal dwellers there.

We know that technically this can be done, because the technique that would be employed is already in use. GOES has used it for some years to broadcast National Bureau of Standards UTC (Coordinated Universal Time). It is a technique that transmits a message one piece at a time and then re-assembles it on the ground into the whole message. It is a technique that utilizes the first four bits of every sequential interrogation or command sent over that 468 MHz link.

Each of these interrogations or commands is 50 bits long and takes 1/2 second at the transmission rate of 100 bits/second. Sixty such transmissions -- in other words 30 seconds -- are used to send the complete time information consisting of years, day, hour, and minute. After the complete time message has been sent, received, and displayed, a 30-second pause could follow, after which the time transmissions would begin again.

This half-minute interval between time transmissions is when the tsunami or other natural disaster warning messages could be sent. During this period, instead of 4 bits of time information, 4 bits of tsunami information would be transmitted every half-second. In the 30 seconds, a warning message comprising 240 bits could be sent. Then another 240 bits a half-minute later and so on... alternating tsunami data with time code data.

The warning message sent in this manner would be short, succinct, and standardized. The elements -- wave arrival time, arrival direction, and the like -- would be standardized as would be memory. The transmission on the DCS downlink would provide the data to "fill in the blanks" in that standardized, pre-prepared, form message. At the warning receiving site, a microprocessor would translate the message with its filled-in blanks into a meaningful text and output it on a printer or display.

Instead of a printout or display, the receiving system could provide a voice alert, using a "talking chip". This type of alert would have more warning impact than a printer or Cathode Ray Tude. It could also be rebroadcast over the local radio to alert the immediate and nearby communities. That "voice chip", furthermore, could be programmed to give its oral warning in the particular language appropriate to the area. Thus, a multilingual oral disaster warning capability could be brought to reality.

What other features might that ground system have?

It could automatically activate warning sirens and alarms.

It could be powered by solar cells and storage batteries for use in the remotest of inhabited places where there may be no reliable, or perhaps no, source of electricity.

The cost of the basic receiving system -- (a) a flat plate antenna small enough to stand on an indoor window sill and with a beamwidth of 60° or more such that it can simply be pointed in the general direction of the satellite, (b) a radio receiver to do what a radio receiver normally does, (c) a microprocessor to store the framework of the standardized message (and fill in its blanks with the incoming data) also to store the vocabulary for the voice ship, (d) the chip itself, and, finally, (e) the audio or loudspeaker -- is estimated at $1000 (U.S.) or less.

This remarkably low cost is anticipated by the fact that essentially this same receiving system is being developed jointly by the National Environmental Satellite Service and the National Weather Service of the United States to broadcast marine weather to ships at sea. The principle is exactly the same: a standardized form message with blanks in it stored in the receiver and incoming data, arriving 4 bits at a time, to fill those blanks. The message length is 300 words, meaning that the vocabulary stored for the benefit of the "talking chip" must be sized accordingly. While all this may sound complicated, the prospects of being able to develop a suitable shipboard receiving system that will sell in production for less than $1000 (U.S.) are excellent and are being pursued.

When such a receiving package, small enough to take up only a small portion of a table top or desk top, comes into being, so, essentially, will also come into being the tsunami warning receiver. They will, of course, be one and the same, except for changes in programming, vocabulary, and the like to enable tsunami warning messages addressed to it via the GOES Data Collection System's downlink to be received and to generate the warning voice output. A permanent or hard-copy output device, such as a printer, could be actuated, as well as, or instead of, the loudspeaker if desired, but, of course, at additional cost.

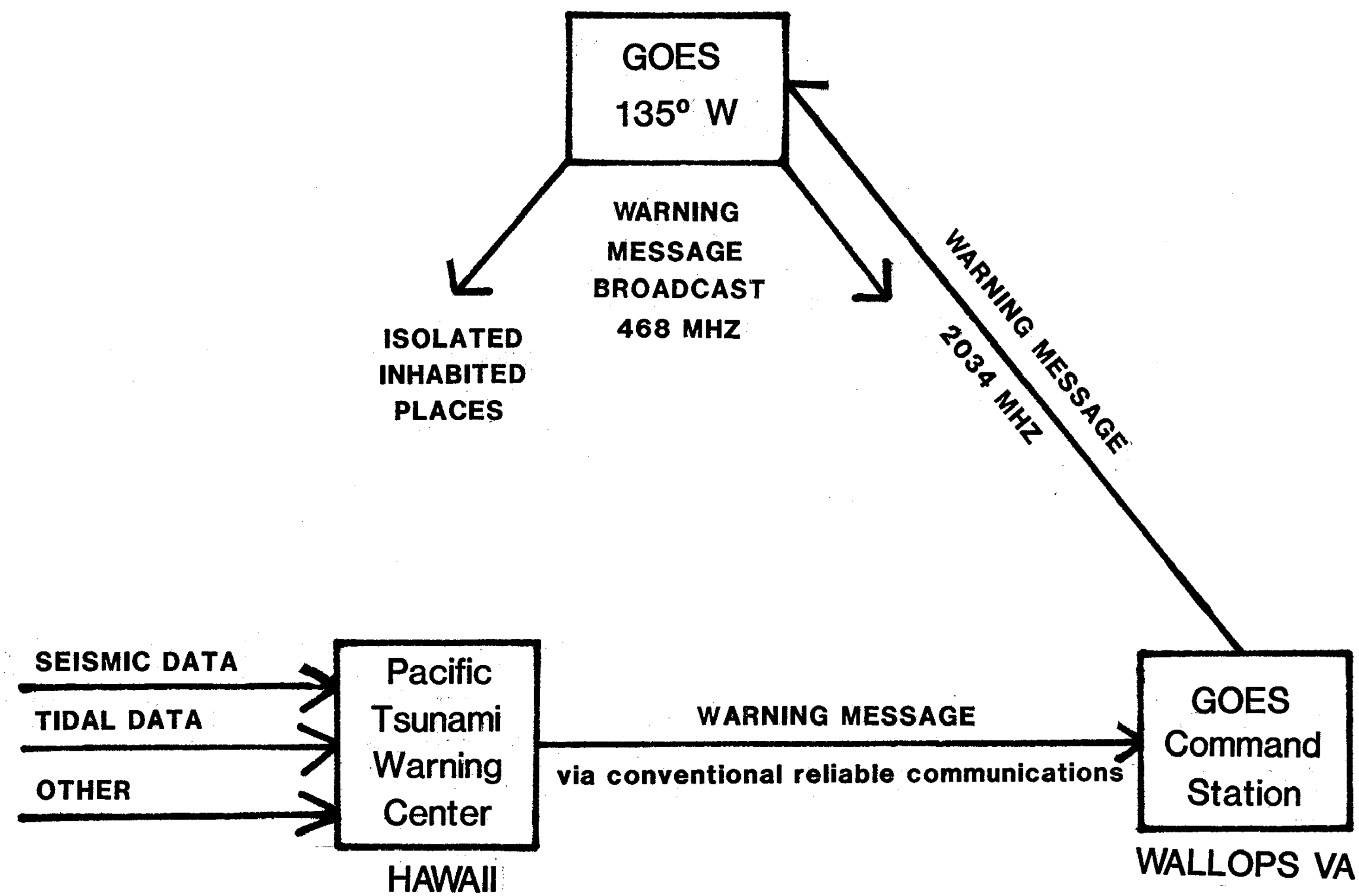
The missing data to fill the blanks in the standardized message stored in the receiving system would be inserted into the GOES Data Collection System interrogation sequence at Wallops, Virginia, by the GOES command and data acquisition facility operated there by the National Environmental Satellite Service. Of course, the data to fill in those blanks must come from an appropriate source. In the case of tsunami warnings affecting the overall Pacific Basin, it would logically be the Pacific Tsunami Warning Center on Oahu in Hawaii. The message content would be prepared at that center based on the various seismic and tidal information available to it. It would then be communicated directly to Wallops where it would be introduced into the interrogation sequences and broadcast 4 bits at a time by the western GOES to the Pacific Ocean area within its radio horizon.

This, then, is how the GOES satellite may someday soon convey tsunami warning messages to the peoples of the Pacific Basin, particularly those who live isolated and removed from conventional and reliable communications. Hopefully the low cost of the receiving system can be afforded by the nations and inhabited places there. The fact that the system will be usable as well to receive general area Pacific marine weather forecasts and is not limited just to tsunami messages will go a long way toward making it affordable and the concept practicable.

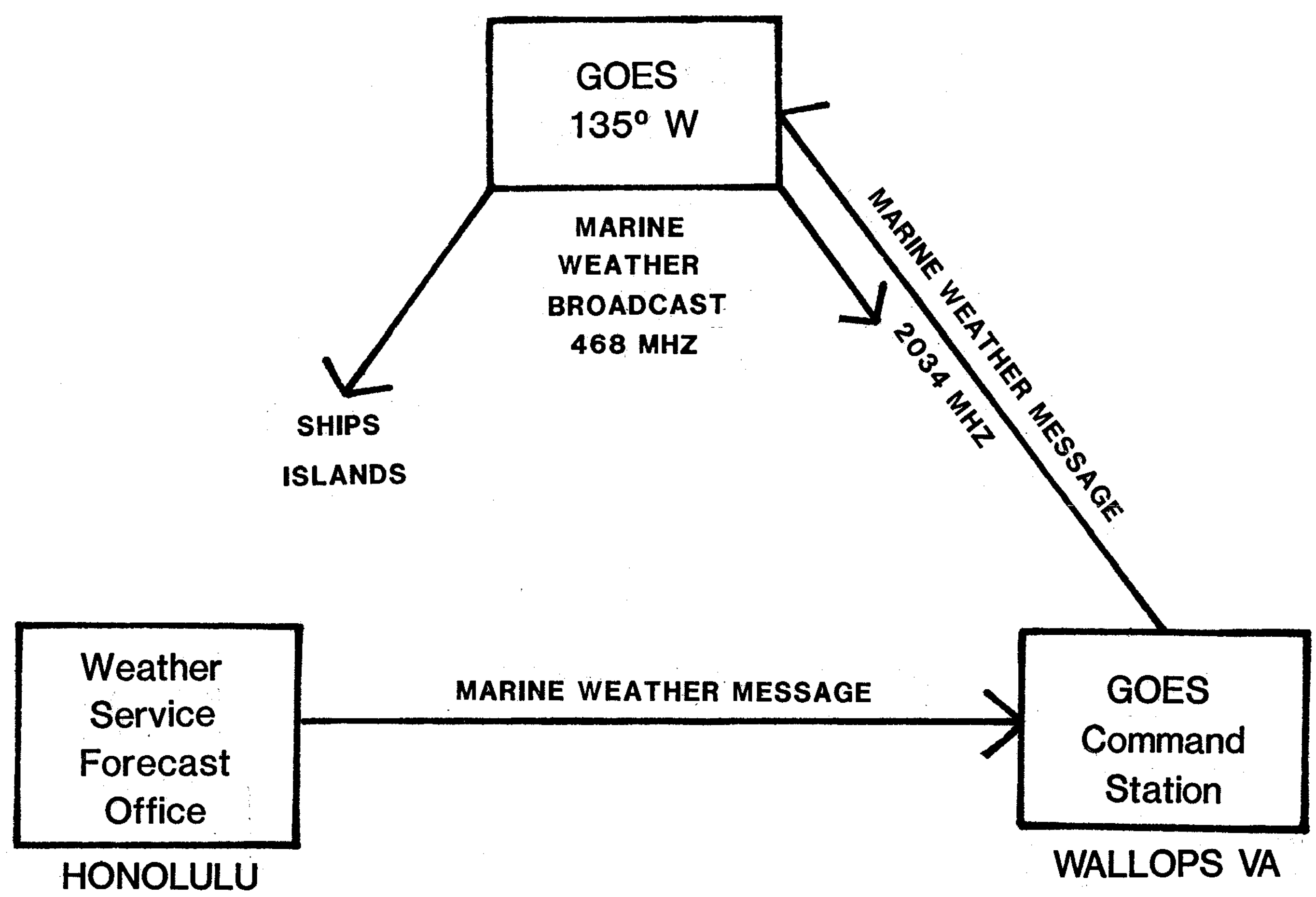
The westernmost GOES, as one can see from its radio horizons, covers a great deal -- but still only a part -- of the tsunami-susceptible Pacific Basin. Where its tsunami-warning broadcast cannot reach, the warnings will have to be received by other means, more than likely, in most cases involving remote and isolated areas, by HF (High Frequency) radio with its vagaries and uncertainties. If Japan's GMS (Geostationary Meteorological Satellite) and *its* data collection system, however, could be applied like GOES to disaster warning broadcasts, then an environmental warning service for essentially the entire Pacific becomes possible.

The course of technological development takes many turns. The synchronous satellite's data collection capability, as it has evolved with GOES, is a case in point. When it was originally decided to make the DCS a part of GOES, its purpose was seen as conveying data *from* remote, isolated, and inaccessible regions. Now, with the operational feasibility and value of that aspect well demonstrated and proven, GOES DCS shows promise of taking on a new and equally important role in an *opposite* direction -- the conveying of disaster warning information *to* remote, isolated, and inaccessible regions.

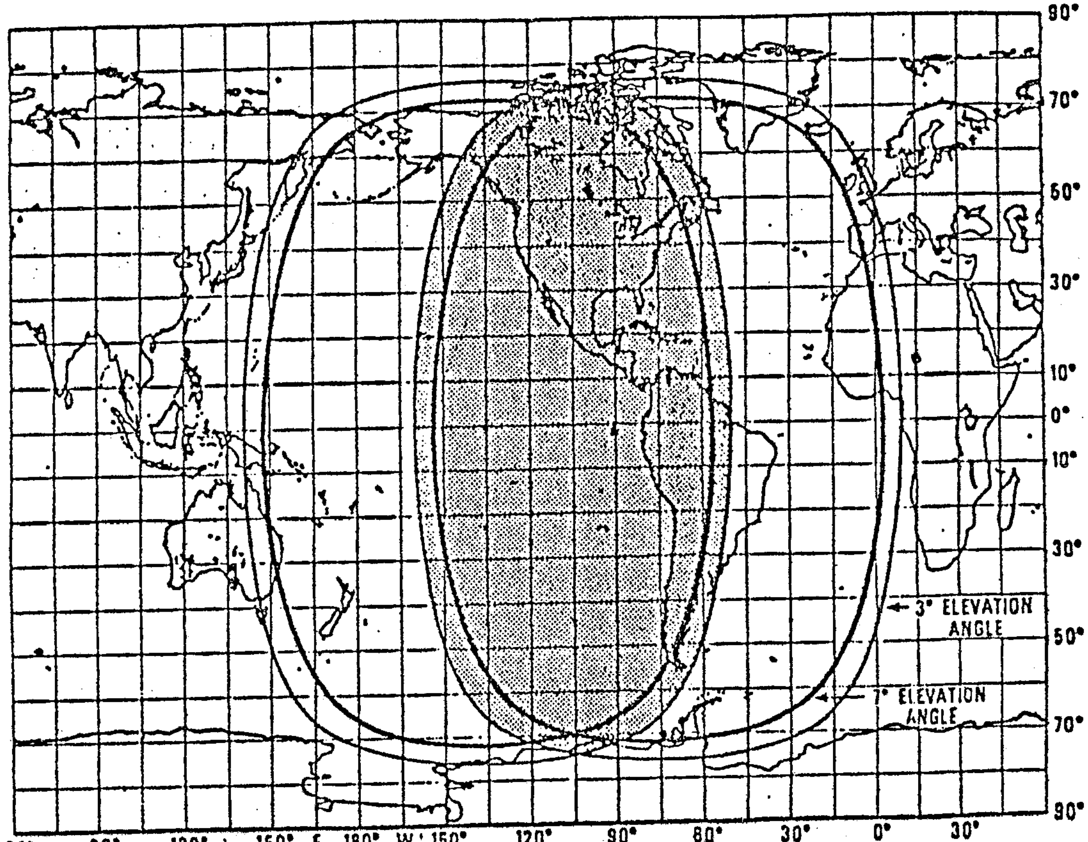
Pacific Disaster Warning



Pacific Marine Weather Broadcast



Coverage Area of the GOES Satellites



(AREA OF EAST AND WEST GOES RADIO OVERLAPS IS SHADED GRAY.)

THE RADIO HORIZON OF THE WESTERN GOES (135° W) COVERS MOST OF THE PACIFIC BASIN

NEWS EVENTS

Kilauea Volcano in Hawaii Erupted

On September 25, 1982, Kilauea Volcano in Hawaii erupted without warning catching scientists by surprise. The eruption, which lasted 14 hours, spewed out 3 million cubic meters of molten rock at the southern end of its caldera. It was the largest eruption since the 19-day eruption on the East Rift Zone in September 1977. The lava destroyed about 400 feet of the crater road.

Tsunami in Java, Indonesia, February 24, 1982

In our last Newsletter, we reported that a "tidal wave" occurred in Indonesia on 24 February 1982 and that further information has been requested from Indonesian Authorities. However, up to this time, we have not received a response to our inquiry. Therefore, we cannot confirm at this time whether this reported event was indeed a tsunami.

International Conference on Physics and Mitigation of Natural Hazards Held in Hawaii

The Conference was held from 16 to 21 of August, 1982 at the East-West Center, Honolulu, Hawaii. Topics covered included:- Risk Analysis, Instrumentation for Natural Hazards, Mitigation of Natural Hazards, Seismic Hazards and Tsunami Hazards. Papers presented in the Conference are as follows:-

Session on Risk Analysis

N. Hulkower & D. Bender. "Asteroids and Comets: The Hazard and Avoidance of Collisions"

J. Morgan. "A Tsunami Susceptibility Index"

R. Razani. "Methods of Reducing Earthquake Damage in Non-ductile Masonry Buildings"

C. Rauw, W. Baird, J. Wilson & C. Scawthorn. "Hazards Risk Assessment - Offshore Runway Extension Design; Unalaska, Alaska"

Session on Instrumentation for Natural Hazards

G. Curtis. "Use of Monte Carlo Models for Studying Hazardous Events"

J. Brune. "Photographic Recording of Structural and Topographic Seismic Amplification Effects in Foam Rubber Models"

D. Hwang. "Aerial Photographic Analysis of Coastal Processes"

W. Van Dorn. "Priorities in Tsunami Research and Instrumentation"

C. Lewis. "The Computer as an Instrument for Mitigating the Tsunami Hazard: Numerical Modeling of Tsunami-Flooding"

Session on Mitigation of Natural Hazards

L. Lau. "History and Critique of Storm Drainage Standards for Honolulu"

P. Jovanovic. "Man's Influence on Extreme Events Causing Natural Disasters"

E. Cheng & A. Chiu. "Stochastic Simulation of Tropical Cyclones' Occurences"

J. McDonald. "Assessment of Tornado Risk"

M. Hamnett & A. Franco. "Disaster Preparedness in the South Pacific: Findings of a Regional Survey"

D. Hwang. "Beach Erosion and Natural Hazard Management"

C. Barrett. "Local Flood Warning Systems"

C. Bretschneider. "A Model Hurricane"

Session on Seismic Hazards

C. Holman. "Seismicity and Seismic Risk from Earthquakes on Maui, Molokai, and Lanai"

J. Brune & L. Manguia. "Results of Ten Years of Digital Recording of Seismic Weak and Strong Motion in Northern Baja California and Southern California"

M. Khan. "Earthquake Hazard Assessment from Satellite and Surface Gravity Consideration"

R. Razani. "Behavior of Buildings and Population in the Earthquakes of February 24, 25, and March 4, 1981 in Athens, Greece"

A. Ryall & F. Ryall. "Potential Volcanic Hazard in the Mammoth Lakes Area, Eastern California"

A. Furumoto. "Honolulu as a Case of Potential Earthquake Hazard"

A. Rapat. "Tsunamis and Earthquakes in the Bay of Bengal"

Session on Tsunami Hazards

C. Bretschneider, H. Krock, F. Casciano & E. Nakazaki. "Friction Factors for Oceanographic Environmental Design"

C. Bretschneider, H. Krock, E. Nakazaki & F. Casciano. "Measurement of Roughness of Typical Hawaiian Terrain"

P. Lockridge. "Tsunami and Seismic Databases of the National Geophysical and Solar-Terrestrial Data Center"

D. Cox. "Importance of Local Contemporary Reports of Effects of Historical Tsunamis in Tsunami Risk Analysis"

M. Blackford. "Use of the Abe Magnitude Scale by the Tsunami Warning System"

S. Nakamura. "A Numerical Tracking of 1883 Krakatoa Tsunami"

W. Adams. "Revising the Grading Specifications for Clayey Soils to Mitigate Landslide Risk"

The Conference also included field trips to the Pacific Tsunami Warning Center, the State of Hawaii Civil Defense, the viewing of landslides on the Southeastern Oahu Island and the viewing of beach erosion and accretion.

Abstracts of papers related to tsunami presented can be found in the Abstracts Section of this Newsletter.

The International Congress on the Application of Emergency Plans to Human Settlements

The Congress, organized jointly by the Urban Emergency Preparedness and Response Office of the Mexican Ministry of Human Settlements and Public Works (SAHOP) and UNDRO, took place in Cancun, Mexico from 22 to 25 of June, 1982.

"The Congress was attended by over 150 participants representing many of the Latin American and Caribbean countries, as well as by specialists from international agencies, universities and institutes who contributed to the proceedings with their expertise in disaster matters. Talks were given on the various aspects of emergency planning, including general principles, health aspects, communications, logistics, assignment of responsibilities, public awareness, disaster warning, rescue, first-aid and medical assistance, etc., and on different countries' experiences in the preparation and application of such plans. During the discussion periods at the end of each session, participants had the opportunity to ask questions and exchange views on the themes covered.

In summing up the general conclusions of the Congress, it was found that four main themes emerged: emergency planning, public awareness, disaster response and long-term recovery. In a proposed resolution generally adopted by the participants at the closing session, it was declared that: The application of Emergency Plans should be regarded as a key element in the overall development of disaster-prone countries. Therefore disaster planning should promote more effective emergency response and should be designed to support long-term development objectives."

(From UNDRO News, Sept./Oct.- 1982, p. 12)

Ad Hoc Committee on Master Plan for Tsunami Warning System Met at ITIC

Resolution 1 of the ITSU-VIII meeting calls for the development of a Master Plan for the International Tsunami Warning System. An Ad Hoc Committee meeting was held at ITIC on August 3, 1982. Dr. George Pararas-Carayannis, ITIC Director, met with G. Dohler, Chairman of ITSU; M. Molchan, Ocean Services Program Coordinator; and S. Wigen, Canadian National Contact of ITSU.

The Committee agreed that a group of experts consisting of about 6 to 10 members should be set up. The members should be selected to provide both technical expertise and regional representation within the Pacific. Participation has been invited from ITSU National Contacts.

The Committee also addressed two specific aspects within the Master Plan -- tsunami instrumentation, and the assessment of natural hazards requiring warning. In the aspect of instrumentation, a questionnaire has been sent out seeking information on certain member states' existing gauging and data transmission systems in order to prepare a list of specifications for an instrument to register and transmit water level that will meet the tsunami warning system requirements. In the aspect of natural hazard assessment, a questionnaire was sent to all ITSU National Representatives to identify the following: populations and industries threatened by tsunami or other marine hazards; source of hazards; and communications and infrastructure now existing for warnings in the member states.

Annotated Tsunami Bibliography Published

The U.S. Nuclear Regulatory Commission has recently published the Annotated Tsunami Bibliography 1962-1976. The Bibliography contains tsunami related papers in English and foreign languages published between 1962 to 1976.

The project initiated in 1976 with support from the U.S. Nuclear Regulatory Commission and the U.S. National Weather Service. Due to the exhaustion of funds, only the data collection phase was completed. In 1981, ITIC resumed the project with additional financial support from the U.S. Nuclear Regulatory Commission and performed the final review and editing task of the Bibliography.

Because of the difficulty in producing a comprehensive annotated bibliography on tsunamis, it is quite possible that some errors have been introduced. Similarly, objections may be raised as to the inclusion of certain publications in the Bibliography. ITIC invites comments, reviews and proposed changes for the Bibliography so that future editions may serve better the needs of the scientific community. Authors are also encouraged to submit abstracts or copies of their publications relating to tsunamis to ITIC to be included in the future up-date of the Bibliography.

Copies of the Bibliography are available for $12.00 per copy from:

The NRC/GPO Sales Program
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555, U.S.A.

Executive Director of the Australian Overseas Disaster Response Organization (AODRO) Visited ITIC

Mr. Robin Morison, the Executive Director of AODRO visited ITIC on October 22. He was escorted by Dr. George Pararas-Carayannis, Director of ITIC, to the Pacific Tsunami Warning Center (PTWC) for familization with operational procedures of the Tsunami Warning Center.

Visitors to ITIC

Recent visitors to ITIC included among others the following:-

Ms. Ruth Egami	Austin, Tsutsumi & Assoc., Honolulu
Mr. Burl Pepper	U.S. General Services Administration
Mr. Keith Matsumoto	East-West Center, Honolulu
Mr. Willem de Lange	University of Waikato, New Zealand
Dr. Petar Jovanovic	National Academy of Science, Yugoslavia
Mr. Robert Williams	Oahu Civil Defense Agency
Mr. David Divoky	Honolulu
Mr. Edward Noda	E.K. Noda & Assoc., Honolulu
Dr. Doak Cox	University of Hawaii
Mr. Fred Wood	North Shore Civil Defence, New Zealand
Ms. Marilyn Kali	State of Hawaii Civil Defense
Dr. Naren Saxena	University of Hawaii
Dr. Adam Zielinski	Memorial University of Newfoundland, Canada
Mr. Robin Morison	Australian Overseas Disaster Response Organization

ITSU-VIII Resolutions and Summary of the National Reports

The Eighth Session of ITSU was held in Suva, Fiji from 13 to 17 April 1982. The following are a summary of the national reports and a list of resolutions and recommendations adopted at the session.

Summary of the National Reports

The Delegate of Canada reported that a new automatic tide gauge station planned at Bamfield, B.C., is expected to be ready for satellite interrogation by 1983 and that pressure sensors, capable depth of 2,500 m off the Canadian west coast. Special attention was paid to the need for certain lines of research which include the assembling of knowledge of past tsunamis, and the evaluation of the probable response of warning system gauges to any tsunami. To develop these concepts, the Delegate of Canada recommended that a task team be established to prepare a Master Plan for International Tsunami Warning System operations, incorporating operations, planning and research.

The Delegate of Fiji stated that five seismic stations telemetered from Suva were installed by the Japanese Aid Programme late in 1981 and this brought the total to 14 seismic stations throughout Fiji. By 1983 it will be possible to locate earthquake epicentres rapidly. However, to make use of this information in the mitigation of tsunami damage, a system for rapid communication to the public is an essential requirement. Mr. Gordon Burton, Director of PTWC, commented on the excellent communication link between the Center and Nadi and the important role that Fiji plays in the Pacific Tsunami Warning System.

The Delegate of Japan described his country's warning procedures and the advances made in automating their warning system. The Permanent Ocean Bottom Seismograph Observation System (OBSOS) off the south coast of the Tokai District, Japan, is operating successfully, and another OBSOS system, due for completion in 1985 is to be set up in the southern Kanto area off Tokyo.

The Delegate of New Zealand stated that the Lyttleton tide gauge is now in operation as a participating tide station. He described the intensive programme of training and education with respect to natural disasters, which has been adopted by the Ministry of Civil Defence.

The Delegate of Peru reported that a new tide gauge station has been established at the island of Lobos de Afuera, 35 miles off the Peruvian coast. The Tsunami Detection Platform installed in Punta Callao by the U.S. National Weather Service is experiencing some minor problems. A real-time seismic activity detection and analysis system is to be installed in 1982 and will increase the seismic detection capabilities in the central region of Peru.

The Delegate of the Philippines reported that disaster risk maps, including data on tsunami occurrences, are being prepared for most of the vulnerable areas. Some problems that previously occurred in the transmission of messages between Legaspi Tide Station and Honolulu have now been overcome. An intensive educational programme has been initiated to minimize the disastrous effects of tsunamis, effects which the Philippines experienced so tragically in 1976 when 8,000 people were killed.

The Delegate of Tonga described the vulnerability of Tonga islands to earthquakes. Seismic stations were temporarily operated some years ago by Cornell University. The Australian National University set up four seismic stations in 1981 but these are now in the process of being removed.

The Delegate of the U.S.A. described improvements that have been made in automatic data processing and in communications instrumentation by the installation of a high-speed paper-tape punch for teletypewriter messages. Four experimental tide station platforms were installed at Easter Island and Antofagasta (Chile), La Punta, Callao (Peru) and Galapagos Islands (Ecuador). The platforms transmit data, via GOES, to PTWC, but some technical and maintenance problems are being experienced at present. Many of the US tide gauges have been automated and PTWC can contact these stations and receive water level data automatically.

Chile reported that twelve tide stations and 21 seismic stations participate in the Warning System. Exercises involving the tidal stations are repidly carried out and response times have been reduced to a minimum. The 21 seismic stations include five new ones which are telemetered from the University of Chile, Santiago.

Hong Kong reported on the participation of the Royal Observatory in the Warning System. Four tide gauges are operated and two of these are telemetered from the Royal Observatory. Another tide gauge is being installed at Waglan Island and will have a telecommunication link with the Observatory.

A report from Papua New Guinea informed the Group that tsunami monitoring is being carried out under the responsibility of the Geophysical Observatory Section (Port Moresby) of the Geological Survey of Papua New Guinea. Rabaul Volcanological Observatory participates in tsunami monitoring and has access to records of two tide gauges: one belonging to the University of Hawaii, and the other maintained by the Papua New Guinea Department of Works.

Resolutions and Recommendations adopted at the Session

RESOLUTION ITSU-VIII.1 -- Development of a Master Plan for International Tsunami Warning Operations

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU),

Being concerned that resources for the improvement of the international Tsunami Warning System be most effectively utilized, Recognizing the need for correlation of international operation, planning and research to achieve this objective,

Noting the high efficiency of the Tusnami Research Plan prepared by the U.S. National Science Foundation,

Recommends that experts nominated for a mission in relation to the mitigation of tsunami hazards in the Pacific would develop a Master Plan for International Tsunami Warning System Operations,

Urges the IOC Secretary to take appropriate action for circulating it to Member States for their comments,

Recommends further that the experts prepare concepts of the implementation of a Master Plan twelve months after approval,

Requests the IOC Secretary to provide support to the preparation, publication and distribution of a Master Plan.

RESOLUTION ITSU-VIII.2 -- Preparation of Additional Travel-Time Charts

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU),

Considering the usefulness of the travel-time charts in ensuring the proper functioning of local emergency preparedness and warning dissemination activities,

Taking into account the necessity of preparing additional charts for utilization in disseminating tsunami warnings in recipient areas,

Requests the Director, ITIC, through the assistance of NOAA-National Weather Service, USA, to prepare additional travel-time charts as required for effective operation of the Tsunami Warning System,

Recognizing that additional financial support is necessary for the preparation of such travel-time charts,

Further requests the Secretary IOC to study possibilities of mobilizing financial support to carry out this task.

RESOLUTION ITSU-VIII.3 -- Establishment of Tsunami Warning Procedures

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU),

Having received the report of the ITSU Task Team on a Study of Tsunami Watch and Warning Procedures,

Noting current practices of the Pacific Tsunami Warning Center (PTWC),

Recommends that PTWC begin issuing Watches and Warnings on a time-stepped basis when there is no clear evidence that a Pacific-wide tsunami danger exists, Recommends further that the initial warning cover areas within three hours tsunami travel time of the epicentre and the initial watch cover areas within three to six hours tsunami travel time of the epicentre. Both areas are to be expanded every hour until it is determined that a danger to the entire Pacific exists or that no further danger exists,

Requests that these procedures be made effective from 1 October 1982.

RESOLUTION ITSU-VIII.4 -- Establishment of Tsunami Warning Systems and Improvement of Present Communications

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU),

Being aware of the fact that many nations of the South Pacific with dense populations separated by wide expanses of water,

Recongizing that their present communications are insufficient and/or lacking between these centres,

Stressing the fact that the installation or improvement of the Pacific Tsunami Warning System in the area should include not only the collection of data through automated tidal gauging stations but must provide the means of delivering warnings in adequate time to endangered areas,

Agrees that such systems could also be used and serve in other emergencies such as warning of storm surges, floods or in mitigation of cyclone disasters,

Recommends that the highest possible priority be given to the installation of national and/or regional Tsunami Warning Systems appropriate to the nations concerned,

Recommends further that Member States approach UNDP and other bilateral/ multi-lateral donors for assistance in the planning, provision and installation of national and/or regional systems,

Recommends also that adequate finances be included for the required communications for rapid dissemination and reception of emergency warnings on a national or regional basis.

RECOMMENDATION ITSU-VIII.1 -- Visiting Scientist Programme

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU),

Noting that the degree of success of the Visiting Scientist Programme has been variable,

Recognizing that the requirements of the Members would, in some cases, be better served by persons expert in other fields of education, instrumentation, communications, disaster preparedness or computer technology, as well as the scientific disciplines, Noting further that this would involve no significant alteration of the budget presently set aside for the programme,

Recommends that the Visiting Scientist Programme be redesignated the Visiting Expert Programme,

Requests the Director, ITIC, to prepare and circulate, in consultation with the Chairman and the IOC Secretariat, a questionnaire to National Contacts seeking the following information:

1. a list of national priorities for the elements noted above;

2. a list of scientific and technical experts and individuals interested in taking part in the Visiting Expert Programme; and

3. a list of training and education requirements in order of priority,

Encourages other Members with a well-established Tsunami Warning System, computing facilities and expertise to provide assistance in the implementation of the programme.

RECOMMENDATION ITSU-VIII.2 -- Proposed Activities and Budget

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU),

I

Having considered the budget the programme of ITSU for 1982,

Recognizing that the budget for the Tsunami Warning System programme for 1983 has already been established,

Recommends that the 1983 budget should take into account the following line items:

- Activities of the International Tsunami Information Center

- Support for the Director and Associate Director, ITIC, to Carry out post-tsunami surveys

- Living allowance and travel for the Associate Director, ITIC

- Support for a study mission of a group of tsunami experts to the countries of the region to determine the precise objectives and work plan for the development of the International Tsunami Warning System in the Pacific

- Staff attendance at subject-related meetings and conferences

- Consultants and visiting experts programme

- Technical studies related to: communications, observations, prediction methods and/or warning centre operations

- Publications, including the new ITSU Handbook, recommended by this meeting,

Requests the Secretary IOC to allocate money for the above-mentioned activities in accordance with established priorities.

II

Noting that the Fifteenth Session of the IOC Executive Council has approved a prospective budget for the 1984-1985 timeframe based on the proposals made by ITSU-VII and the Chairman of the Group,

Further noting Recommendation ITSU-VIII.3 by which this meeting has agreed to hold two meetings during the period 1982-1985,

Requests the Secretary to secure sufficient additional funds to support the successful conduct of ITSU-X scheduled to be held in Sidney, British Columbia, Canada, in 1985.

III

Bearing in mind the necessity to provide guidance to the IOC Secretariat on the Unesco Medium-Term Plan 1984-1989,

Recommends that the Secretary anticipate and secure appropriate funds to support the following programmes:

1. A survey of the data requirements for the Pacific-wide Tsunami Warning System sufficient to provide adequate warnings for teleseismic events (e.g. confirming the existence of tsunami waves within one hour after a seismic event);

2. A review of communications facilities and requirements with special emphasis on the adoption of satellite telemetry technology where feasible to minimize response times after seismic events occur;

3. Missions to the countries of the region to provide assistance in the further development of regional tsunami warning centres and of a Pacific-wide Tsunami Warning System; and

4. An educational programme for the general public, including materials in the form of brochures, slides and films providing information and guidelines on evacuation procedures and disaster preparedness.

RECOMMENDATION ITSU-VIII.3 -- Improvement of Co-operation with the IUGG Tsunami Committee and Place and Time of the Next Two Sessions

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU),

Taking note of the IUGG Tsunami Committee, Japan, 25-28 May 1981 Resolution to endorse the co-ordination of ITSU and IUGG meetings in conjunction to make possible joint attendance, Believing this will maximize the use of funding for the attendance of experts and country delegates,

Noting that an IUGG meeting with a Tsunamis Symposium included (which does not occur in every IUGG meeting) is scheduled for Sidney, British Columbia, Canada, August 1985,

Understanding that it has been made clear and resolved that all ICG-ITSU meetings will always be held in a Pacific country,

Recognizing that there will be 41 months between the present Eighth Session and the Sidney, Canada, August 1985 IUGG meeting,

Accepts with appreciation a kind invitation of Canada to have the Tenth Session of ICG/ITSU in Canada, in juxtaposition with the IUGG Tsunamis Symposium,

Invites IOC Member States of the Pacific to study possibilities for holding the Ninth Session of ICG/ITSU in one of the Pacific countries, preferably Hawaii, USA,

Decides that flexibility in timing and location of meetings will maximize attendance and minimize funding and should be kept in mind for all future Sessions of ICG/ITSU,

Requests the Secretary IOC to note well and fund accordingly the necessity of shortening slightly the next two biennial Sessions from two years to approximately 21 months to the Ninth Session, and beyond that approximately 20 months to the Tenth Session. Otherwise the intersessional time will be inordinately long and impetus of Projects will be jeopardized.

List of National Contacts of ICG/ITSU

The following is a list of National Contacts of ITSU members on file in the ITIC office. Please inform ITIC if there are any changes.

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COLOMBIA	Capitan de Navio Gustavo Angel Mejia Presidente Comision Colombians de Oceanografia Bogota, Colombia
COOK ISLANDS	Commissioner L. J. Todd Police National Headquarters P.O. Box 101 Rarotonga, Cook Islands
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GUATEMALA	Ing. Jose Vaussaux Palomo Jefe de Departamento de Sismologia Division del Observatorio Meteorologico Nacional Ministerio de la Agricultura Palacio Nacional, Guatemala
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UNITED KINGDOM (HONG KONG)	Mr. J. E. Peacock Hong Kong Royal Observatory Nathan Road Kowloon, Hong Kong
USA	Mr. Mark G. Spaeth U.S. National Coordinator for ITSU U.S. Department of Commerce NOAA/National Weather Service Oceanographic Services Branch W161 Silver Spring, Maryland 20910 U.S.A.
USSR	Mr. P. Agafonov Oceanographic Committee of the Soviet Union Gorky Street 11 Moscow 103009, USSR
WESTERN SAMOA	Superintendent Apia Observatory P. O. Box 52 Apia, Western Samoa

Director, ITIC

Dr. George Pararas-Carayannis
Director
International Tsunami Information Center
P. O. Box 50027
Honolulu, Hawaii 96850
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(Cable Address: ITIC HONOLULU)

Chairman, ICG/ITSU

* Mr. Gerry C. Dohler
Canadian Hydrographic Service
Room 316, 615 Booth St.
Ottawa, Ontario, K1A OE6
Canada

* Until further notice please forward all mail to:

Mr. Gerry C. Dohler
Chairman, ITSU
International Tsunami Information Center
P. O. Box 50027
Honolulu, Hawaii 96850
U.S.A.

Twelfth Session of the IOC Assembly

The above mentioned session was held in Paris, France from 3 to 20 November 1982. The following is a Provisional Agenda of the Assembly.

1. OPENING

2. ADMINISTRATIVE ARRANGEMENTS

    2.1 ADOPTION OF THE AGENDA
    2.2 DESIGNATION OF THE RAPPORTEUR
    2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION
    2.4 CONSTITUTION OF SESSIONAL COMMITTEES

3. ADOPTION OF THE TRIENNIAL REPORT OF THE COMMISSION

4. OCEAN SCIENCES

    4.1 OCEAN SCIENCE FOR THE YEAR 2000
    4.2 OCEAN SCIENCE IN RELATION TO LIVING RESOURCES (OSLR)
    4.3 OCEAN SCIENCE IN RELATION TO NON-LIVING RESOURCES (OSNLR)
    4.4 OCEAN MAPPING AND GENERAL BATHYMETRIC CHART OF THE OCEANS (GEBCO)
    4.5 OCEAN DYNAMICS AND CLIMATE
        4.5.1 Large-scale Ocean Experiments
        4.5.2 Scientific Basis for Ocean Monitoring
        4.5.3 Programme Implementation
    4.6 MARINE POLLUTION RESEARCH AND MONITORING
        4.6.1 Plan of Action for the Implementation of the Global Investigation of Pollution in the Marine Environment (GIPME)
        4.6.2 Development of a Marine Pollution Monitoring System (MARPOLMON)
        4.6.3 Health of the Oceans

5. OCEAN SERVICES

    5.1 INTEGRATED GLOBAL OCEAN SERVICES SYSTEM (IGOSS)
        5.1.1 State of Implementation
        5.1.2 Regional Implementation
        5.1.3 Use of Drifting Buoys for Oceanographic and Other Purposes
    5.2 INTERNATIONAL OCEANOGRAPHIC DATA EXCHANGE AND MARINE INFORMATION MANAGEMENT
    5.3 STANDARDIZATION OF OCEANOGRAPHIC PROCEDURES, SYMBOLS, UNITS AND NOMENCLATURE
    5.4 TSUNAMI WARNING SYSTEM IN THE PACIFIC

6. TRAINING, EDUCATION AND MUTUAL ASSISTANCE IN THE MARINE SCIENCES (TEMA)

    6.1 COMPREHENSIVE PLAN FOR A MAJOR PROGRAMME OF ASSISTANCE TO ENHANCE THE MARINE SCIENCE CAPABILITIES OF DEVELOPING COUNTRIES

6.2 TEMA COMPONENTS OF IOC PROGRAMMES

7. IMPLICATIONS FOR THE IOC OF DEVELOPMENTS IN INTERNATIONAL AFFAIRS

7.1 ELEVENTH SESSION OF THE UN CONFERENCE ON THE LAW OF THE SEA
7.2 AD HOC TASK TEAM TO STUDY THE DRAFT CONVENTION ON THE LAW OF THE SEA AND ANY FUTURE TEXT DEVELOPED BY UNCLOS, AND THE IMPLICATIONS FOR THE COMMISSION
7.3 UPDATING OF THE LONG TERM AND EXPANDED PROGRAMME OF OCEANIC EXPLORATION AND RESEARCH (LEPOR)
7.4 INTERNATIONAL CONFERENCE ON OCEAN DATA ACQUISITION SYSTEMS (ODAS)

8. MEDIUM-TERM PLAN, PROGRAMME AND BUDGET

8.1 UNESCO MEDIUM-TERM PLAN (1984-89)
8.2 IOC PROGRAMME AND BUDGET FOR 1984-85
8.3 PROGRAMME AND BUDGET OF THE UNESCO DIVISION OF MARINE SCIENCES

9. STRUCTURE AND FUNCTIONING OF THE COMMISSION AND ITS REGIONAL SUBSIDIARY BODIES

9.1 NEW MECHANISMS FOR CO-OPERATION
9.1.1 Concept of IOC Regional Sub-Commissions
9.1.2 Machinery for the Implementation of the Programmes of Ocean Science in Relation to Living Resources and of Ocean Science in Relation to Non-living Resources
9.2 REGIONAL SUBSIDIARY BODIES
9.2.1 IOC Association for the Caribbean and Adjacent Regions (IOCARIBE)
9.2.2 Programme Group for the Western Pacific (WESTPAC) and Joint Bodies
9.2.3 Programme Group for the North and Central Western Indian Ocean (CINCWIO)
9.2.4 Programme Group for the Southern Oceans (SOC)
9.2.5 Proposed Activities for Western Africa
9.3 FREQUENCY AND TIMING OF EXECUTIVE COUNCIL SESSIONS

10. AGREEMENTS WITH OTHER ORGANIZATIONS OF THE UN SYSTEM AND OTHER BODIES

10.1 INTER-SECRETARIAT COMMITTEE ON SCIENTIFIC PROGRAMMES RELATING TO OCEANOGRAPHY (ICSPRO)
10.2 UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)
10.3 INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
10.4 INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES)
10.5 INTERNATIONAL COMMISSION FOR THE SCIENTIFIC EXPLORATION OF THE MEDITERRANEAN SEA (ICSEM)

11. ANTON BRUUN MEMORIAL LECTURES

12. ELECTIONS

12.1 ELECTION OF THE OFFICERS OF THE COMMISSION
12.2 ELECTION OF THE MEMBERS OF THE EXECUTIVE COUNCIL

13. DATES AND PLACES OF THE THIRTEENTH SESSION OF THE ASSEMBLY AND OF THE SEVENTEENTH AND EIGHTEENTH SESSIONS OF THE EXECUTIVE COUNCIL

14. ADOPTION OF THE SUMMARY REPORT

15. CLOSURE

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

The IOC was established as a semi-autonomous body within UNESCO in 1960. Its purpose is to promote scientific investigation with a view to learning more about the nature and resources of the oceans through the concerted action of its members'. At present, 105 countries are members.

The current activities of IOC are:

Ocean sciences: at the global and regional levels;

Ocean services: data exchange, network of oceanographic stations, oceanographic data products, tsunami warning system;

Training, education and mutual assistance (TEMA). The policy and planning aspects of these functions are dealt with in the subsidiary bodies, e.g. working committees, international co-ordination groups, programme groups, working groups, or groups of experts of the Commission.

An overview of the IOC's history and activities appeared in the International Marine Science Newsletter, No. 32, Summer 1982, pp. 7-8.

NATIONAL AND AREA REPORTS

TSUNAMI STATIONS INSPECTION

The Pacific Tide Party personnel completed the inspection for the following stations:

Sitka, Alaska	June 16-20, 1982
Adak, Alaska	June 28-July 2
Sand Point, Alaska	July 7-10
Unalaska, Alaska	July 10-15
Kodiak, Alaska	August 1
Seward, Alaska	August 6
Wake Island	August 18-23

ANNOUNCEMENTS

International Earthquake Conference

The above mentioned conference is sponsored by the City of Los Angeles, University of Southern California, Southern California Earthquake Preparedness Project, Federal Emergency Management Agency and the U.S. Agency for International Development Office of Foreign Disaster Assistance. It will be held from February 7 to 11, 1983 in Los Angeles, California. The Conference will address all facets of earthquake preparedness and response for police, fire, health and building safety departments, schools, volunteer organizations, utilities, the media, and business and industry. Designed for policy makers and administrators, the program will focus on what is necessary to local governments in order to develop, evaluate and implement earthquake mitigation and response policies.

For more information, write to:

Councilman Hal Bernson
City Hall Room 236
200 North Spring Street
Los Angeles, CA 90012-4190
U.S.A.

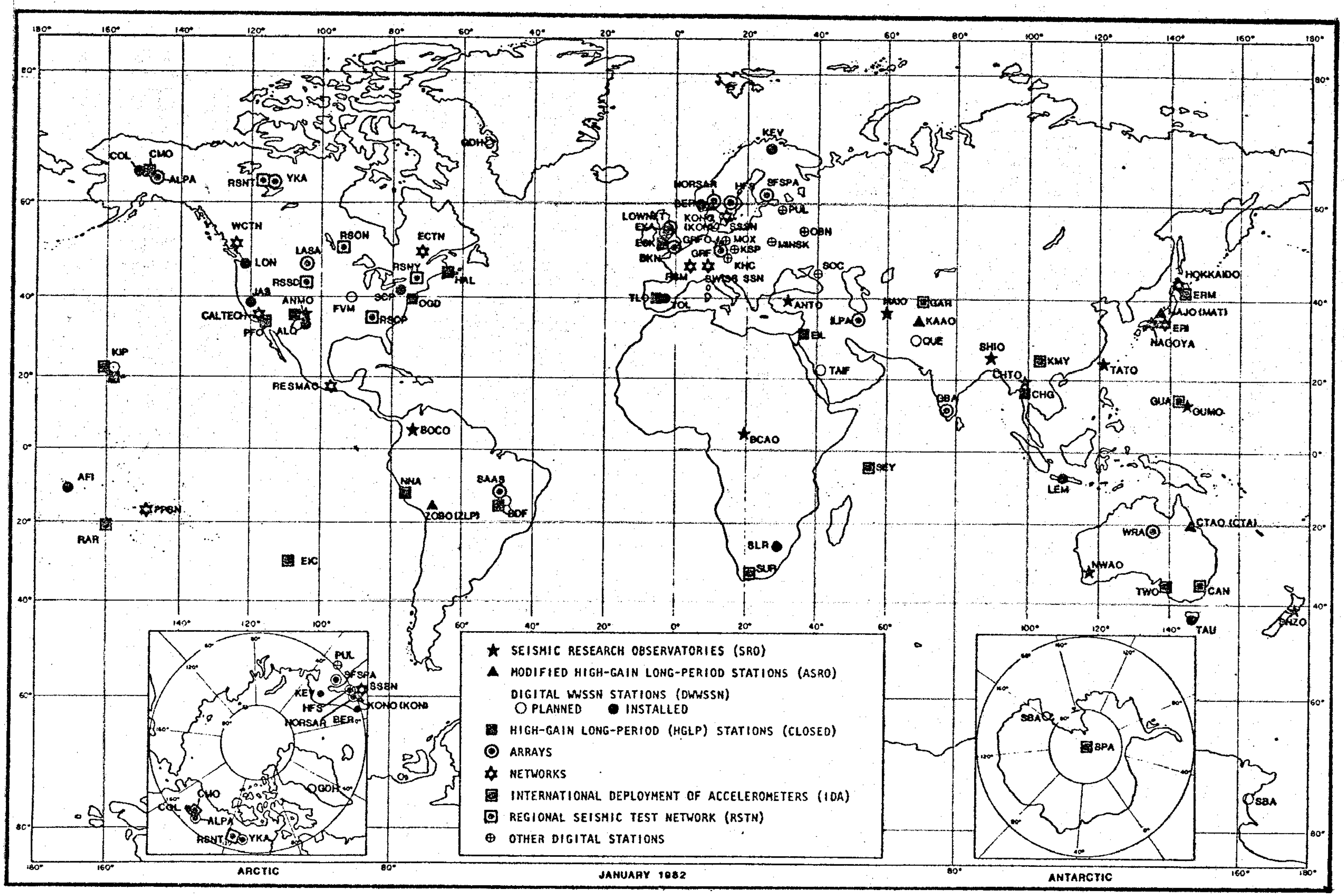
(Excerpted from Natural Hazards Observer, September 1982)

Directory of World Digital Seismic Stations Available from World Data Center A for Solid Earth Geophysics

The National Geophysical Data Center and World Data Center A for Solid Earth Geophysics, in cooperation with the U.S. Geological Survey, have published a detailed catalog of world seismological stations, open and closed, that record digital data. The types of stations and number of countries with stations of each type described are: Seismic Research Observatory (12), Modified Seismic Research Observatory (5), High-gain, long-period (8), Digital World-Wide Seismic Station Network (13), national arrays (11), national networks (8), International Deployment of Accelerometers (15), regional seismic test networks (2), others (4). For each station, correspondence information, detailed descriptions of site and instrumentation, data formats, and references are usually given. In many cases response curves and maps of region geology and instrument layouts are included. SRO/ASRO Network-day tape and tape formats and DWWSSN tape format are described in appendixes.

Report SE-32, Directory of World Digital Seismic Stations, August 1982, 439 pp., contains a foldout map (shown reduced on the next page) and map key for the 93 stations and arrays described. It is available for $25 post paid. Inquiries should be directed to:

World Data Center A for Solid Earth Geophysics
National Geophysical Data Center
NOAA, Code E622
325 Broadway
Boulder, CO 80303



WORLD DIGITAL SEISMIC STATIONS

Nature and Resources Available from UNESCO

"Nature and Resources", a quarterly journal published by UNESCO, provides international news, and information about UNESCO programmes concerning environmental activities, natural resources research and conservations. It has a circulation of 12,000 in 138 countries.

At the beginning of each issue, three or four main articles dealing with environment-related themes of international significance are normally presented. The second section contains shorter technical articles plus the official news and announcements pertaining to the Programme on Man and the Biosphere, the International Hydrological Programme, and the International Geological Correlation Programme. The third section reviews UNESCO's own environment and natural resources publications as well as new items of general interest in these fields. In the final section, "Nature and Resources" analyzes the contents of 40-50 titles in various environmental disciplines.

It is published in English, French and Spanish language editions. Subscription rate for one year is 32 Francs. Order can be made from:

Nature and Resources
UNESCO
7 Place de Fontenoy
75700 Paris, France

ABSTRACTS

Hydraulic Behaviours of Flood Flows and Tidal Waves in River Channels observed by Ultrasonic Methods

Takeo Kinosita
National Research Center for Disaster Prevention, Japan

[Report of the National Research Center for Disaster Prevention, No. 27, March 1982, pp. 1-11]

A parabolic univalent curve of a relation between water stage and discharge, so-called an H-Q curve, is used for obtaining discharge for daily water management. But it is inadequate in the case of an unsteady flow, for instance a flood flow or a tidal wave. Because the H-Q curve of an unsteady flow is not a univalent function, but forms loops. Although a numerical analysis of an unsteady flow has been developed to make clear hydraulic behaviours of an unsteady flow, a classic H-Q curve is still being widely used for operational purposes.

The discharge observations by means of the ultrasonic method have been much improved in Japan. They are available to measure continuous discharges without using H-Q curves. The author analyzes the relation between the water stage and the discharge measured by the ultrasonic methods. Fig. 3 shows the H-Q curve at Tome Station in Kitakami River,

which forms counterclockwise loops. Fig. 5 shows the H-Q curve at Fukawa Station in Tone River which forms clockwise loops. A flood flow which propagates downstream forms a counterclockwise loop, while a tidal wave which propagates upstream forms a clockwise loop. The direction of the loops is explained by combining the equations (16), (17) and (18). The amplitudes of H and Q can be calculated by this analysis as shown by the equation (19). The outlet discharge from a big lake can also be observed by the ultrasonic method as shown in Fig. 7. The H-Q curve in such a case, as illustrated in Fig. 8, is explained by the equation (21) and is similar to the upper part of Fig. 10.

The new information based on these facts provides us with better managements of water resources, especially for flood control and water utilization in lower basins of big rivers.

[In Japanese]

Buoy Techniques for Obtaining Directional Wave Spectra

M. Tokuda
Hiratsuka Branch, National Research Center for Disaster Prevention, Japan
and
S. Eguchi
Institute of Industrial Science, University of Tokyo

[Report of the National Research Center for Disaster Prevention, No. 27, March 1982, pp. 247-278]

Buoy techniques of a pressure-type wave meter, which is attached to gimbals, were newly developed for obtaining directional wave spectra.

Response of heaving and pitching motions of the buoy to the regular wave mechanically generated was investigated in the towing tank. The wave period used ranged from 1.0 sec. to 3.0 sec. The natural periods of heave and pitch from the free damping test were approximately 1.25 sec. and 0.87 sec., respectively. Because of the high damping, the amplitude response factor of heave did not differ much from unity for $\geqq$ 1.3 sec., and that of pitch for $T \geqq 2.0$ sec. However, the scattering of data in pitch was rather large.

In conclusion, the presented results indicates that there still remains a great room for improvement with respect to the pitching motion of the buoy.

[In Japanese]

Focal Mechanisms of Micro Earthquakes off the East Coast of Izu Peninsula, Japan, from August 1980 to May 1981

Masajiro Imoto
National Research Center for Disaster Prevention, Japan

[Report of the National Research Center for Disaster Prevention, No. 27, March 1982, pp. 133-144]

Focal mechanisms of 18 micro earthquakes, which occurred off the east coast of Izu Peninsula during the period from August 1980 to May 1981, are studied in relation to the seismicity change in this region. Azimuth of the tension axis for strike-slip type earthquakes distributes in the direction between N and NE. Earthquakes with the tension axis striking between NNE and NE seem to be located linearly in NNW trend. On the other hand, two earthquakes with nearly N-S tension axis are located in the north-western part of the source area. Both the shocks took place in coincidence with increase of local seismicity in this region. These results are consistent with features of the swarm activity in this region from June to July, 1980, for example, linear distribution of earthquakes with NNE tension axis, occurrence of earthquakes iwth nearly N-S tension axis at the initial stage of the swarm activity, and so on.

[In Japanese]

Determination of Earthquake Magnitude from Total Duration Time of Seismic Waves in the Kanto-Tokai Observational Network of the NRCDP

Mizuho Ishida and Mariko Tatsukawa
National Research Center for Disaster Prevention, Japan

[Report of the National Research Center for Disaster Prevention, No. 27, March 1982, pp. 119-131]

In May 1980, twenty-six seismic stations were operating under the Kanto-Tokai observational network of the National Research Center for Disaster Prevention (NRCDP). All of the data from these stations are being telemetered to the NRCDP and have been routinely processed since 1979.

By using those data, a linear relation between logarithmic total duration time of seismic waves (F-P time) and earthquake magnitude determined by the Japan Meteorological Agency (JMA) was obtained for the eighteen stations that had been in operation since July 1979. The earthquakes analyzed are those which occurred during the period bounded by latitudes 33.7°N and 37.3°N, and longitudes 136.7°E and 141.7°E by the JMA. Their magnitude was distributed from 1.7 to 5.7 in JMA magnitude scale (M_{JMA}).

The relations between F-P time and magnitude obtained from seismograms of different sensitivities and personal errors in reading F-P times were examined. It is concluded that the relations obtained in this study are applicable to a wide range of magnitude from 1.7 to 5.7. This method is not only simple and convenient but also very reliable for the estimation of the magnitude of local earthquakes.

The relations between magnitude and F-P time obtained in the present study have been used for the determination of F-P magnitude in the routine-base data processing at the NRCDP. Those relations will be examined also for the stations newly established since June 1980.

[In Japanese]

On Seiches in Nagasaki-Bay

Hideo Akamatsu
Meteorological Research Institute, Tsukuba, Japan

[Papers in Meteorology and Geophysics, Vol. 33, No. 2, June 1982, pp. 95-115]

The seiche in Nagasaki-Bay, i.e. ABIKI in Japanese, is discussed from three stand-points. Firstly, the statistical aspects of the seiche in Nagasaki-Bay are studied by use of the observed data from 1961 to 1979. Secondly, the seiche which occurred on March 31, 1979, the largest one in the history of tidal observation in Nagasaki-Bay is studied. The maximum amplitude of the seiche observed at Matsugae-quay, located at the middle part of the bay, was 278 cm and the period was about 35 minutes, while it was 478 cm at the mouth of the Urakami-river located at the northern end of the bay. This seiche may be due to the severe barometric pressure jump associated with the apparent cold air front which advanced over the sea west of Kyushu. Thirdly, the response of Nagasaki-Bay to the forcing at the mouth of the bay is examined by means of a two-dimensional numerical model. Results show that the bay has an eigen period of 35 minutes, 20 minutes and 10 minutes as the uni-, bi-, tri-nodal oscillations of the bay, respectively. These periods agree with the predominant periods observed. According to the report of Hibiya and Kajiura (1981), the dominant periods of long waves that reached the Goto-Nada sea area are 64, 36 and 24 minutes. Since the latter two periods are very close to the eigen periods of Nagasaki-Bay, it is reasonable ot consider that the seiches of Nagasaki-Bay are caused by the resonance to the long waves due to the barometric pressure jump.

[In Japanese]

Philippine, Solomon and New Hebrides Islands Tsunamis Observed along the Coast of Japan, 1971-1980

Tokutaro Hatori
Earthquake Research Institute

[Bulletin of the Earthquake Research Institute, Vol. 57, 1982, pp. 221-237]

During the past 10 years (1971-1980), seven tsunamis which generated in the Philippines, Solomon and New Hebrides Is. regions were observed by tide-gauges in Japan. According to the USCGS, (US Coast and Geodetic Survey), the earthquake magnitudes were in the range of M_S=7.2 to 7.9. These tsunamis caused much damages to villages near their origin with waves 1-4 meters high. From the amplitude-distance diagram, the tsunami magnitudes (Imamura-Iida scale: m) were determined to be m=1.5 to 2.5. In the present paper, tsunami amplitudes and travel times along the Japanese coast were investigated.

Maximum double amplitudes of the 1975 Philippine (Samar Is.) tsunami averaged about 20 cm with the wave period of 15 min, and southwestern Japan recorded a localized maximum of 40 cm. The initial wave front reached southwestern Japan in 3.5 hours and then propagated along northeastern Japan 1.0 hour later. The farther north the Philippine tsunami source is located the quicker the tsunami reaches Japan. Thus, a tsunami originating in the Luzon Is. area reaches Japan 30 min quicker than one originating in the Mindanao Is. area. The magnitudes of the Solomon-New Hebrides tsunamis depended on the earthquake magnitude. Double amplitudes were 10-20 cm along the Japanese coast and tsunami travel times were 6 to 8 hours.

Field Survey of the Tsunamis Inundating Ofunato City -- The 1960 Chile and 1933 Sanriku Tsunamis

Tokutaro Hatori, Isamu Aida, Morio Koyama and Toshiyuki Hibiya
Earthquake Research Institute

[Bulletin of the Earthquake Research Institute, Vol. 57, 1982, pp. 133-150]

Ofunato, located on the southern Sanriku coast in northeastern Japan was hit by the Sanriku tsunami on June 15, 1896 and March 3, 1933 and by the Chile tsunami on May 24, 1960. In the 1933 Sanriku tsunami, Ofunato was not hit as bad as the neighboring regions. The 1960 Chile tsunami hit the whole Japanese Pacific coast, and Ofunato in particular suffered severe damage. The wave-height of the 1933 Sanriku tsunami decreased toward the head of Ofunato Bay, while that of the 1960 Chile tsunami increased, exciting the seiche period in the bay. At Ofunato and Akazaki, 432 houses were washed away or destroyed and 52 persons were drowned.

Traces of the inundated level on many houses in Ofunato caused by the 1960 Chile tsunami can still be seen while the levels of the 1933 Sanriku tsunami can be learned from many inhabitants. Based on the traces, the inundation heights of the two tsunamis' run-up on land at Ofunato and Akazaki were surveyed, using the automatic level from Oct. 20 to 23, 1981. The relation between the geographical distribution of the inundation heights and the damage to houses was investigated. The results of the present surveys are as follows:

1) The inundation heights of the 1960 Chile tsunami at the coast were 4.5-5.0 m above M.S.L. Ground about 5.0 m above M.S.L. was inundated. In the northern region of the Suzaki River, the inundation height increased, and the ordinary Japanese wooden type houses were destroyed or washed away when the water reached 2.0 m above ground. Although the wave-period of the 1960 Chile tsunami was as long as 50-60 min, the profiles of inundation heights at the various regions in Ofunato varied greatly as the water levels rose or fell inland. It suggests that the water velocity on land was controlled by the local topography and the bulding-to-land ratio.

2) The inundation heights (above M.S.L.) of the 1933 Sanriku tsunami were 2.0-2.5 m at Ofunato and 3.0-3.5 m at Akazaki. Hardly any houses at Ofunato were washed away, but 50 houses at Akazaki (Shuku, Oikata and Yamaguchi) were destroyed. The damage to houses caused by the 1933 Sanriku tsunami between in Ofunato and in Akazaki was different from that by the 1960 Chile tsunami.

[In Japanese]

The following are abstracts of papers related to tsunami presented at the International Conference on Physics and Mitigation of Natural Hazards.

A Tsunami Susceptibility Index of Hazard

Joseph Morgan
University of Hawaii, & East-West Center

Tsunamis strike coasts and penetrate inland, creating conditions hazardous to both people and property in a zone which is particularly valuable from the standpoint of desirability for living and certain economic activities. The hazard from tsunamis can be computed, based on two factors; (1) the probability that a tsunami of X runup height and Y inland inundation distance will strike a coast, and (2) and the extent of habitation of the same stretch of coast. If either of these factors is zero, there is no hazard. The first factor can be estimated for tsunami-prone areas by means of the coastal flood-insurance maps. The second factor is a function of the number of people and the value of property within the zone. A Tsunami Susceptibility Index (TSI) can then be computed by multiplying factor 1 by factor 2. In that way, if either is equal to zero, then the product is equal to zero and there is no hazard.

The TSI is computed by using the 100 year tusnami runup height as a measure of factor 1. Factor 2 consists of the sum of a number of sub factors, each related to human use of the tsunami hazard zone. The sub factors are activities such as housing, schools, hospitals, retail business, hotels, ports, marinas, fish canneries, etc. Points are assigned to each activity, with the greater number of points assessed to activities which are the most hazardous to life and which do not need to be located near the coast. Lessor point scores are assigned to each activities which are dependent on a coastal location. Thus, we might assign 30 points if a hospital is lcoated in a tsunami hazard zone, but only 5 points for a wharf.

The TSI, once computed, can be used by governmental planning agencies to assess the degree of hazard in any coastal region. Further, it can be used to make decisions as to what additional structures and activities might be logically permitted in a region susceptible to tsunamis.

Priorities in Tsunami Research and Instrumentation

W. G. Van Dorn
Scripps Institution of Oceanography, University of California, San Diego

Ongoing analysis of very long (6-day) tide records of large tsunamis at a plurality of stations has provided a new insight into several aspects of tsunami behavior. For example, it might be possible to estimate tsunami damage potential at an arbitrary location from analysis of short-term recordings of local background.

At the same time, our government has been fit to divorce the activities of tide recording and tsunami warning, while simultaneously altering both types of instruments so that they do not provide information adequate for the above analyses.

Where we go from here may involve careful examination of research and instrumentation needs, and perhaps a reordering of national priorities.

The Computer as an Instrument for Mitigating the Tsunami Hazard: Numerical Modeling of Tsunami Flooding

Carter H. Lewis III
Hawaii Institute of Geophysics, University of Hawaii

An explicit, split-step, midpoint-leapfrog, finite-difference analog to the nonlinear, shallow-water, Navier-Stokes equations is developed for application to the modeling of tsunami-flooding. A homogeneous, incompressible, inviscid fluid subject only to the forces of gravity and bottom-friction is assumed. Vertical advection of momentum is permitted.

A theoretical stability-analysis is preformed, yielding constraints on the permissible space- and time-steps necessary to insure a stable solution. It is concluded that the finite-difference scheme is a consistent approximation to the governing differential equations when the stability requirement is observed.

An evaluation of the most common numerical moving-boundry treatments shows each to be restricted assumptions made regarding special conditions existing in the neighborhood of the moving boundary. As a result, a heuristic flooding scheme is developed which allows the prognostic equations to be applied without prejudice uniformly across the entire computational grid.

Careful comparison of experimental results with a known, analytical solution is essential to produce a verified model. Model performance is appraised by recording all results as a motion picture, then viewing the results to detect computational anomalies and to assess spatial and temporal coherency. Various formulations of the nonlinear advection term are tested for stability in this fashion, and effects produced by filtering are examined.

Tsunami and Seismic Data Bases of the National Geophysical and Solar-Terrestrial Data Center

Patricia A. Lockridge
Environmental Data and Information Service, NOAA

The Environmental Data and Information Service (EDIS) has been given the task of collecting, managing, and disseminating the great mass of information produced by the scientific observation of the physical environment. Earthquake data bases include files which give location and magnitude, files which list only significant earthquakes, and files which contain intensity observations. Analog seismograms are available from the Worldwide Network of Standard Seismographs, other networks, and from worldwide stations through international data exchange. Historical seismograms (from 1903) are available for selected earthquakes. Strong-motion earthquake data includes the most significant strong-motion records from the U.S. and other areas of the world for 1933-81. The Earthquake and Tsunami Photograph Files contain about 2,000 photographs of earthquake and tsunami damage plus 250 seismicity and intensity maps.

Tide records (1850 to present) from Pacific tide stations for selected seismic event dates are available. Bathymetric data (500 million U. S. coastal bathymetric observations collected since 1930) are available on magnetic tape which can be formatted for specific needs. The Pacific Tsunami Historic File which has been compiled by Doak Cox is now being put into a database management system. When complete, it will allow users to obtain information on reported local effects, references, source region, and other parameters. It will be possible to select all events originating in or affecting a defined geographic region, or all events of a particular size. EDIS has a number of data bases which will be valuable research tools to those involved in earthquake and tsunami research and mitigation.

Importance of Local Contemporary Reports of Effects of Historical Tsunamis in Tsunami Risk Analysis

Doak C. Cox
Environmental Center, University of Hawaii

To a continuing Pacific tsunami cataloguing effort has been added an intensive review of the history of tsunamis in Hawaii, based so far as possible on local, contemporary sources of information on the events. Through this review, events erroneously included as tsunamis in previous historical compilations have been identified as such, some tsunamis and possible tsunami events have been identified that were not included in previous compilations, and, for the definitely and possibly occurring tsunamis, reported runup heights and reports of effects from which runup heights may be estimated have been found that are not represented in the previous compilations.

The methods used in searching for information on the historic tsunamis, and the kinds of documents in which the information may be found, are discussed briefly in this paper. It is shown that the corrections and additions to the information in earlier compilations, yielded by historical studies such as that described, may be highly significant in the evaluation of tsunami risk from place to place, as for example in the estimation of tsunami hazard zones in the National Flood Insurance Program of the United States.

The results of the search for and use of local contemporary records of historic tsunamis in Hawaii and of similar studies in Japan indicates that such studies should be undertaken more generally, although the availability of pertinent records may not in all coastal regions be as great as in Hawaii and Japan.

Use of the Abe Magnitude Scale by the Tsunami Warning System

M. E. Blackford
Alaska Tsunami Warning Center, NOAA

Using the magnitude scale of Abe developed in 1975 to quantify the size of tsunamigenic Pacific-basin earthquakes from the pre-instrumental era, it is possible, by inverting the process, to estimate maximum potential tsunami heights for the largest expected seismic events in the region.

The Abe scale is directly related to the moment magnitude scale (M_W) through correction factors based upon observed gauge heights for various tsunami source and receiver pairs around the Pacific rim. In the pre-seismic realm a prediction of potential tsunami heights can be derived from the areal extent of gaps in the seismicity or other factors which determine the maximum expected magnitude for a given area. In the co-seismic realm a timely determination of the moment magnitude would enable the forecasting of likely tsunami heights for various Pacific-rim receiver areas. The recent installation of minicomputer systems at the Pacific and Alaska Tsunami Warning Centers, that include real-time data digitization capabilities, makes possible the timely determination of the moment magnitude for major earthquakes.

A Numerical Tracking of 1883 Krakatoa Tsunami

Shigehisa Nakamura
Shirahama Oceanographic Observatory, Kyoto University

1883 Krakatoa Tsunami around the Sunda Strait was studied by using a simple numerical model of finite difference method which had already been established in a computer programme. It is well known the fact of 1883 Krakatoa Eruption but the tsunami. As the author reviewed some of the old publication concerned to Krakatoa Eruption, he felt it to be necessary to track 1883 Krakatoa Tsunami numerically. For simplicity, equivalent parameters for the tsunami source were introduced as Nakamura did in numerical tsunami models previously, that is, vertical displacement of water surface in the source area and its duration time. The source area in the numerical computation was assumed to be almost same to the area of Krakatoa Island. Grid spacing was taken to be 22 km to east and west in the area of 4°S to 9°S and 102°E to 108°E. The author tried to find properties of the tsunami front, arrival time and tsunami height on the basis of the numerical computation. Estimated value of the wave energy trapped in the Sunda Strait was about 54% of the initial increase of an equivalent potential energy at the tsunami source area as a vertical displacement of the water surface. This result seems to be suggestful for a tsunami in a strait or channel of similar dimension, for example, the Kii Channel in Japan.

Tsunamis and Earthquakes in Bay of Bengal

Arun Bapat
Central Water and Power Research Station, India

The presently available data on earthquake and tsunamis generally indicate that most of the tsunamis originate as a result of occurrence of earthquakes and majority of the tsunamis are confined within Pacific Plate. Though there are few evidences of occurrences of tsunamis in the Atlantic, Adriatic, Mediterranean and other seas, the maximum tsunamis have occurred mostly on the border of Pacific Plate.

Andaman Island Region which lies at the Southeastern tip of the Alpine-Himalayan belt is known for its major seismic and minor volcanic activity. During the period 1900-1980 of the recorded history in this region defined by 7.0° - 22.0°N and 88.0° - 100°E it has experienced 348 earthquakes and the magnitudewise distribution of these events is as given in Table I. The records of Tsunamis in the Andaman Island Region is given in Table II. The records of volcanic eruption is given Table III. It could therefore be seen that the number of tsunamis in the Andaman Region is very small as compared to the large number of earthquakes. The Ports of Madras and Calcutta have tide gauges for last few decades and from the tide records of these places do not indicate severe tsunamic effects on these ports. The 1941 Andaman earthquake with magnitude 8.5 had also not been able to generate any big tsunami. The available historical data do not indicate any destruction due to tsunamis on eastern coast of India. However, there are large number of records of cyclonic destructions all along the eastern coast from Pondicherry to Decca. It is observed that under similar conditions earthquakes in Sea of Japan, Philippines, Latin America etc. have been able to generate enough tsunami.

The non-occurrence of tsunamis in the Andaman Island Region of the Bay of Bengal, inspite of favourable geographic, oceanographic and seismotectonic location, is highly interesting and intriguing to seismologists. The author was not able to find any suitable explanation to the question and thought it appropriate to communicate the observations.

Papers on Tsunami from the USSR

ITIC has recently received a number of abstracts on tsunamis from the USSR. Due to the length of this issue, these abstracts will be published in the next issue of the Newsletter.

Translations of 3 USSR Papers in English received from Canada

ITIC has also received from Canada translations of three USSR Papers in English. The translations were performed by the Translation Bureau of the Multilingual Services Division, Department of the Secretary of State of Canada. These three USSR Papers are:

"Tsunamis", by S. L. Soloviev. Zemlya Vselennaya, 3:12-16, 1980.

"Defence Against Tsunamis", by S. L. Soloviev. Priroda, 5:54-67, 1981.

"Selection of a scale for tsunami zoning of the coast", by S. L. Soloviev and I. V. Tulupov. Okeanologiya XXI:38-41, 1981.

PACIFIC TSUNAMI WARNING CENTER

Surplus Tsunami Equipment Available

The Alaska Tsunami Warning Center has shipped to the Pacific Tsunami Warning Center some surplus tsunami equipment. The equipment includes--ten tsunami transmitters (float activated) Bristol Model #OKCIX685M-15: two 0'-10', five 0'-20' and three 0'-30'; and twenty-two four-inch tsunami recorders Bristol Model #IMIM670: two 0'-10', fifteen 0'-20' and five 0'-30'. These equipment are available to countries who may be able to use them in the International Tsunami Network. As the tsunami transmitters are of float activated type, countries choose to use the transmitters would have to install a float well using a float in the desired tide gauge area. Any country interested in any of these equipment should write to:

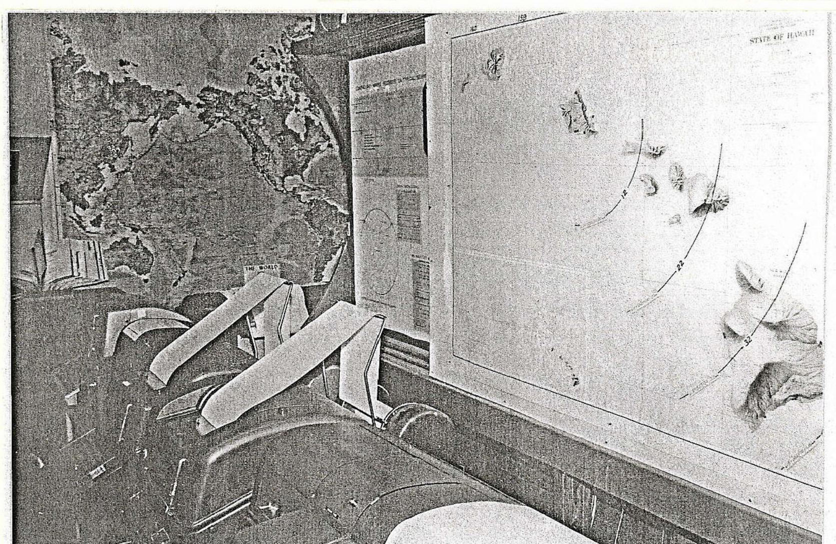
Director
International Tsunami Information Center
P. O. Box 50027
Honolulu, Hawaii 96850

Seismic Summary (July 1, 1982 to Press Time)

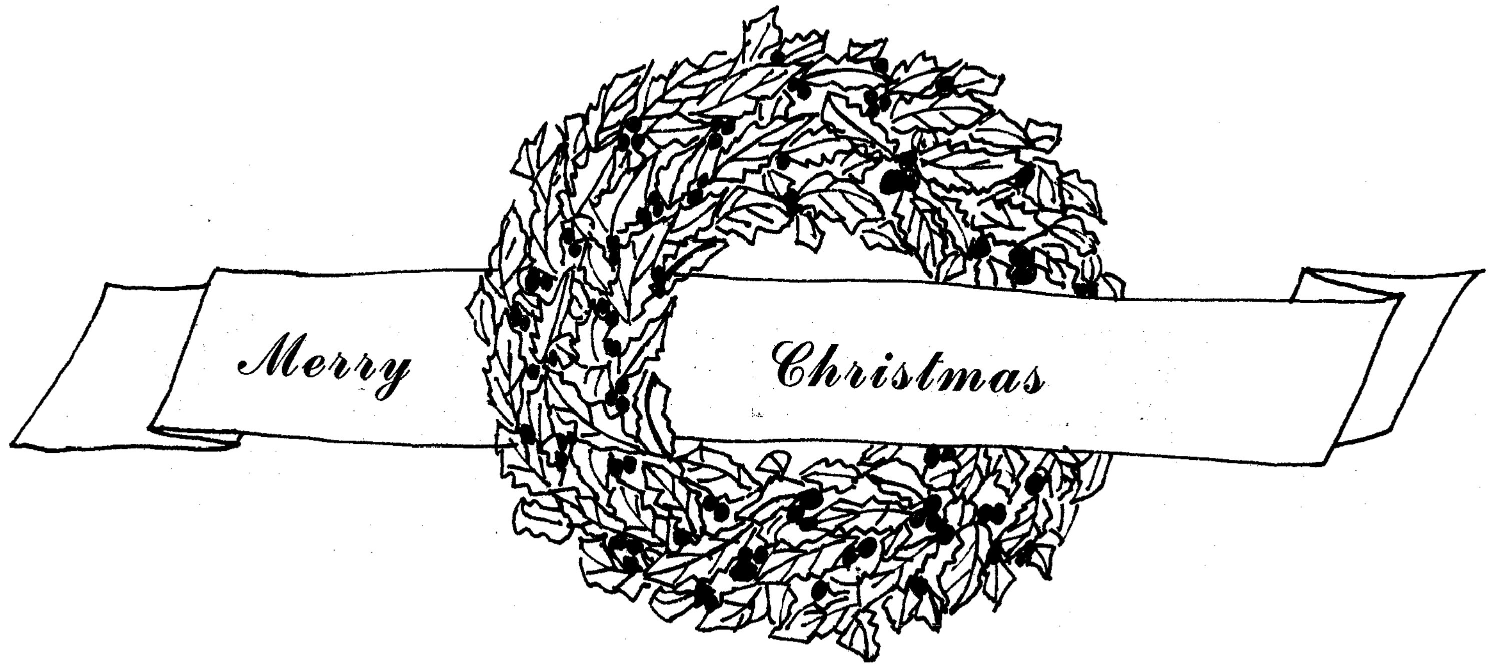
EVENT NO.	EVENT	LOCATION	ACTION TAKEN
1982-10	July 7 1043 (UT) (PTWC) 6.7	Kurile Islands 44.7N 150.6E	Press Release. Tide gauge record requested.
1982-11	Aug 5 2033 (UT) (PTWC) 7.1	Santa Cruz Islands 100 km South of 10.7S 166.6E	Press Release. Tide gauge record requested.
1982-12	Aug 19 1559 (UT) (PTWC) 6.8	Northwest Panama 8.0N 82.0W	Press Release. Tide gauge record requested and received.
1982-13	Sept 14 1817 (UT) (PTWC) 6.5	Solomon Sea 7.0S 149.0E	No Press Release.

Instrumentation racks at PTWC showing Helicorder Seismographs on the left and Tide Gage Recorders on the right.

Richard Sillcox, staff Geophysicist, at the Computer Consul for Tsunami Data Aquisition System (TDAS).



The Teletype Circuits, Backbone of the Telecommunication Network.



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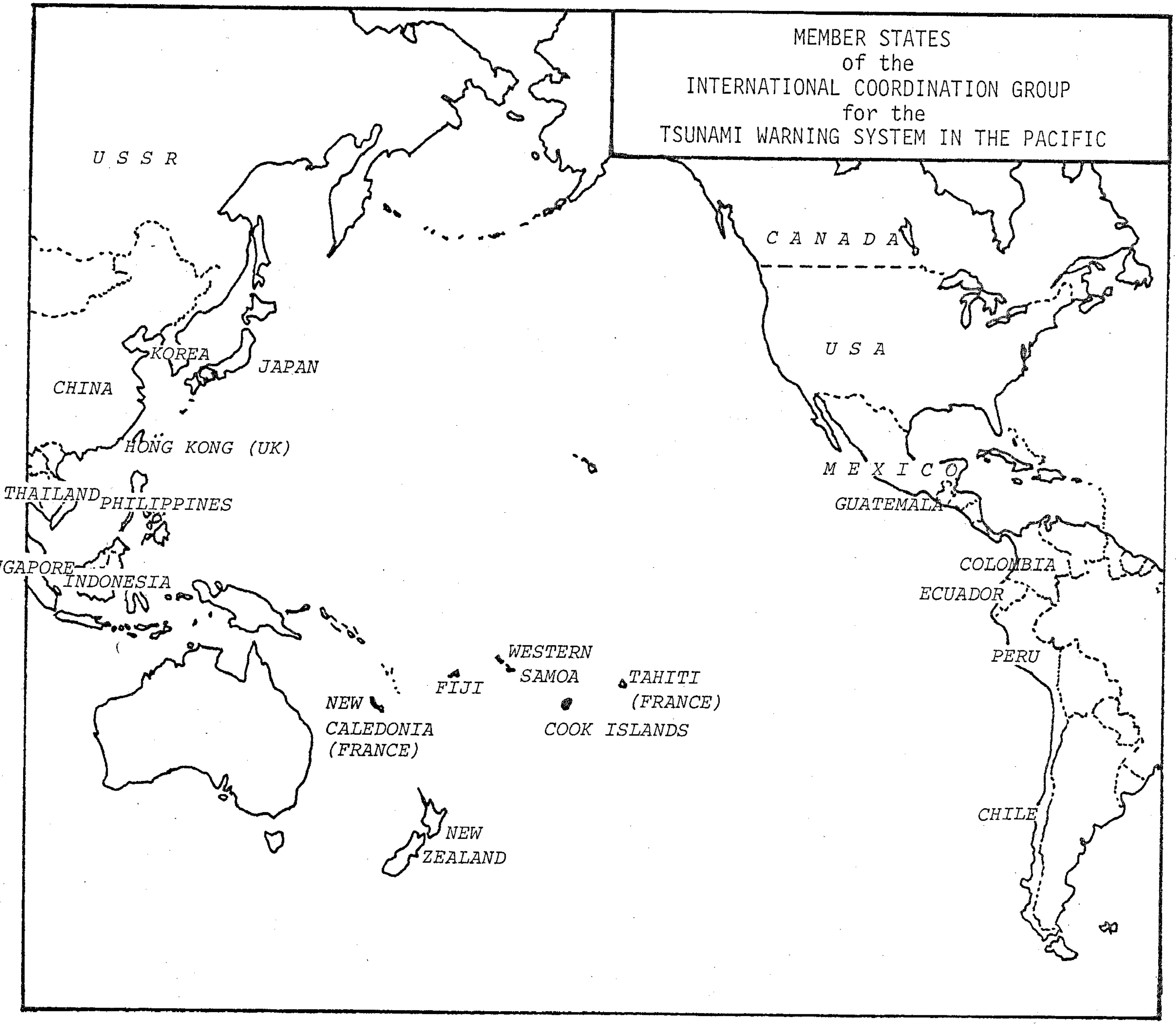
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